

Version control with `git` for scientists

<https://forge.uclouvain.be/elic/learning.git>



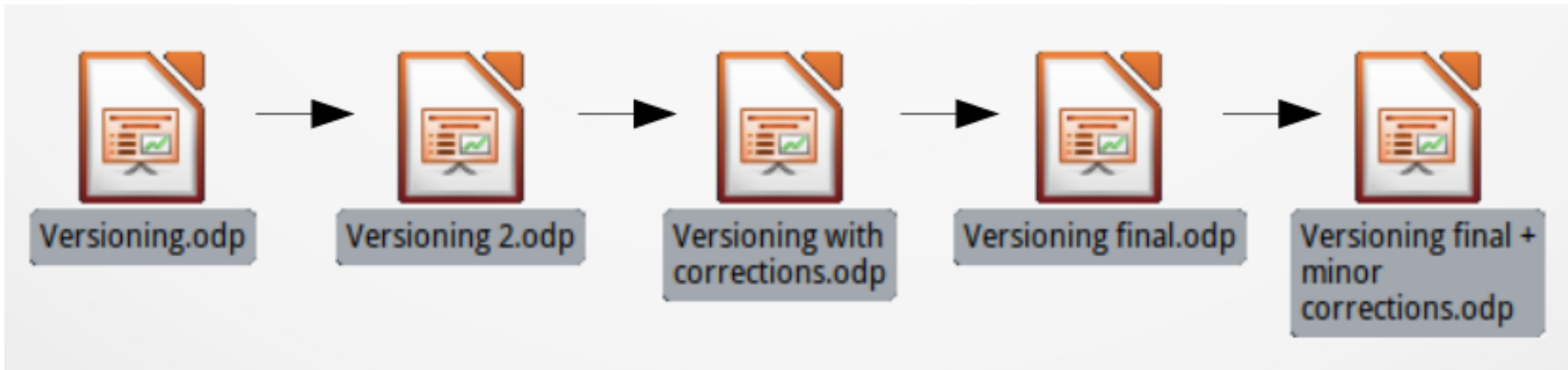
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ACELI Training Sessions `May 20th, 2025`

Discuss

How do you manage different file versions ?

How do you work with collaborators on the same files ?






Notions of code versioning

Track the history and evolution of the project

think of it as a series of snapshots (**commits**) of your code

Benefits

- possibility to go back in time 
 - tracking bugs
 - recovering from mistakes
- Information about the modification 
 - who, when, why

- team work 
 - **Simultaneous** work on a project
 - No need to send email to say "I'm working on that file" (dropbox organization)
 - **Asynchronous** synchronisation
 - Allow work Offline (opposite to overleaf project)
 - Need conflict resolution

Different usage

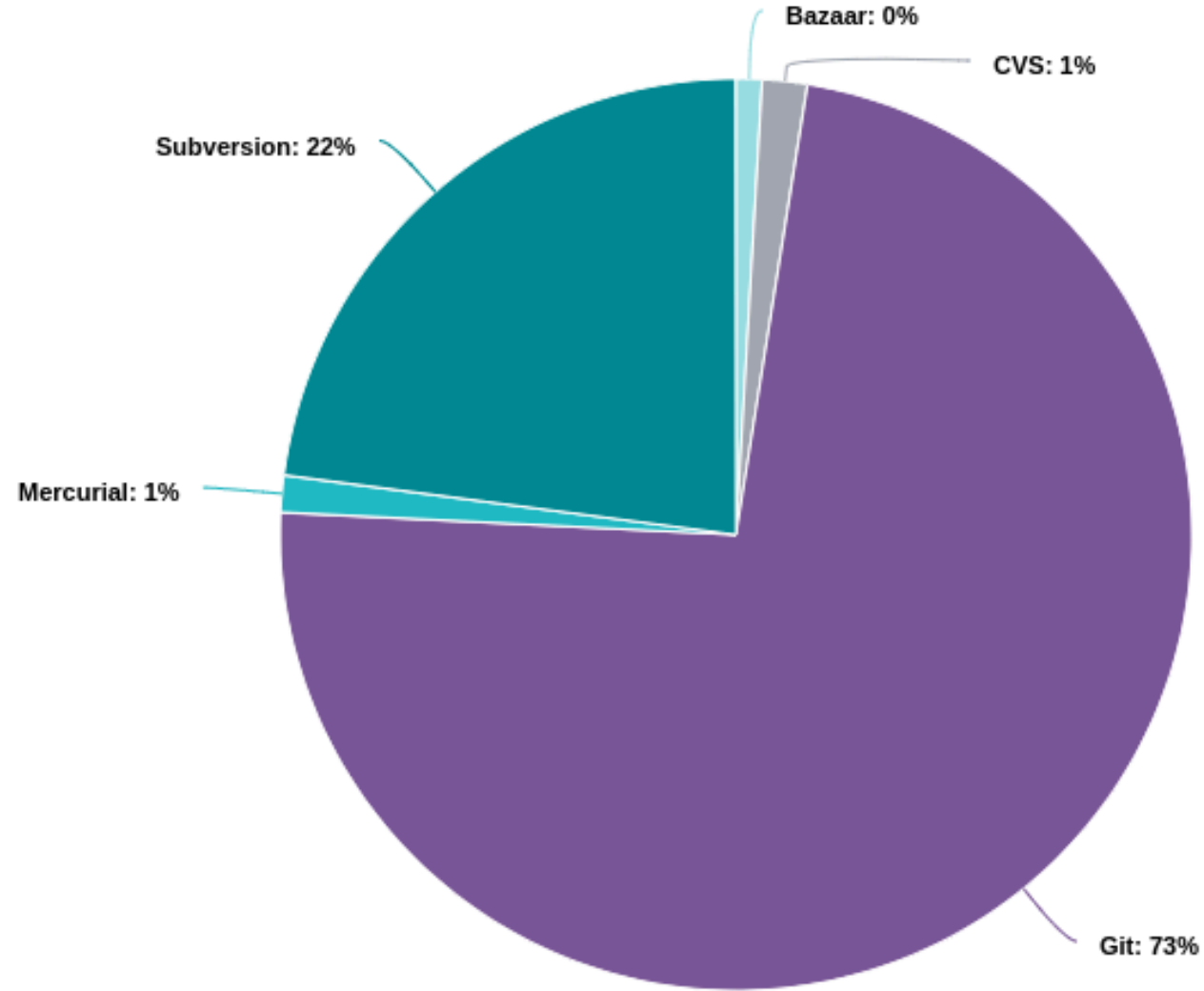
- local
- client-server (Subversion)
- distributed (Git)

Workflow

Testing new idea (and easy way to throw them out) 🚧

Multiple version of the code

- Stable (1.x.y)
- Debug (1.x.y+1)
- Next "feature" release (1.x+1.0)
- Next "huge" release (2.0.0)



Open-Source Code

Compare Repositories

What is `git` ?

Version control system

- Manage different versions of files
- Collaborate with yourself
- Collaborate with other people

Why use `git`

"Always remember your first collaborator is your future self, and your past self doesn't answer emails"

Christie Balhai 🤔

Difference between `git` & GitHub ?

`git` is the version control system **service**

| `git` runs local if you don't use GitHub

`GitHub` is the hosting service : **website**

| on which you can publish (push) your git repositories and collaborate with other people

GitHub

- It provides a backup of your files
- It gives you a visual interface for navigating your repos
- It gives other people a way to navigate your repos
- It makes repo collaboration easy (e.g., multiple people contributing to the same project)
- It provides a lightweight issue tracking system

... and **GitLab**

GitLab is an open-source self-hosted alternative to **GitHub**

GitLab is free for unlimited private projects. **GitHub** doesn't provide private projects for free

The **UCLouvain Forge** is a **GitLab** instance: <https://forge.uclouvain.be/>

Shares the same features : dashboard, file browser, issue tracking, groups support, CI/CD, etc

GitLab : comprehensive DevOps platform, integrated CI/CD, and security features

GitHub : user-friendly interface, robust collaboration tools, and extensive community support

git workflow

Your local repository consists of **three areas** maintained by `git`

- the first one is your **Working Directory** which holds the actual files
- the second one is the **INDEX** which acts as a staging area
- and finally the **HEAD** which points to the last commit you've made



Workspace



`./WORKDIR`

Index



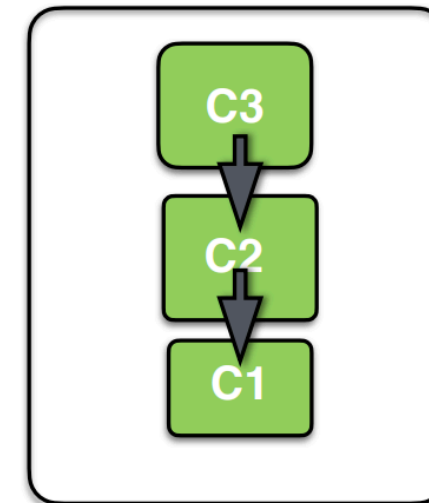
`.git/index`

Staging area

Repository



`.git/`



Windows : use `git` in VSCode

Visual Studio Code is one of the most popular and powerful text editors used by software engineers today

Free and available for [macOS](#), [Windows](#), and [Linux](#)

Linux: `wget` the **deb** package then `dpkg -i code*.deb`

Prerequisite

To use `git` in VSCode, first make sure you have `git` [installed on your computer](#)

keep everything by default during the install process

Configure `git` in VSCode

- Open Settings (JSON) and add the properties to the end of the page :

```
{  
  "terminal.integrated.profiles.windows":  
  {  
    "Git Bash":  
    {  
      "path": "C:\\Program Files\\Git\\bin\\bash.exe"  
    },  
  },  
  "terminal.integrated.defaultProfile.windows": "Git Bash"  
}
```

- Reopen VS Code
- Open a new terminal

Getting started with `git`

checkout a remote repository

create a local working copy of a remote repository

```
git clone https://forge.uclouvain.be/elic/learning.git
```

add & commit

you can propose changes (add it to the **INDEX**)

```
git add <filename>
```

you can commit these changes (to the **HEAD**)

```
git commit -m "Commit message"
```

commit

`git` versioning is a succession of snapshot of your files at key time of their development

each snapshot is called **commit** which is :

- all the files at a given time
- a unique name (SHA1)
- metadata
 - who created, when, info
- pointer to previous(es) commit(s)

Your changes are now in the **HEAD** of your local working copy.

push

to send those changes to your remote repository

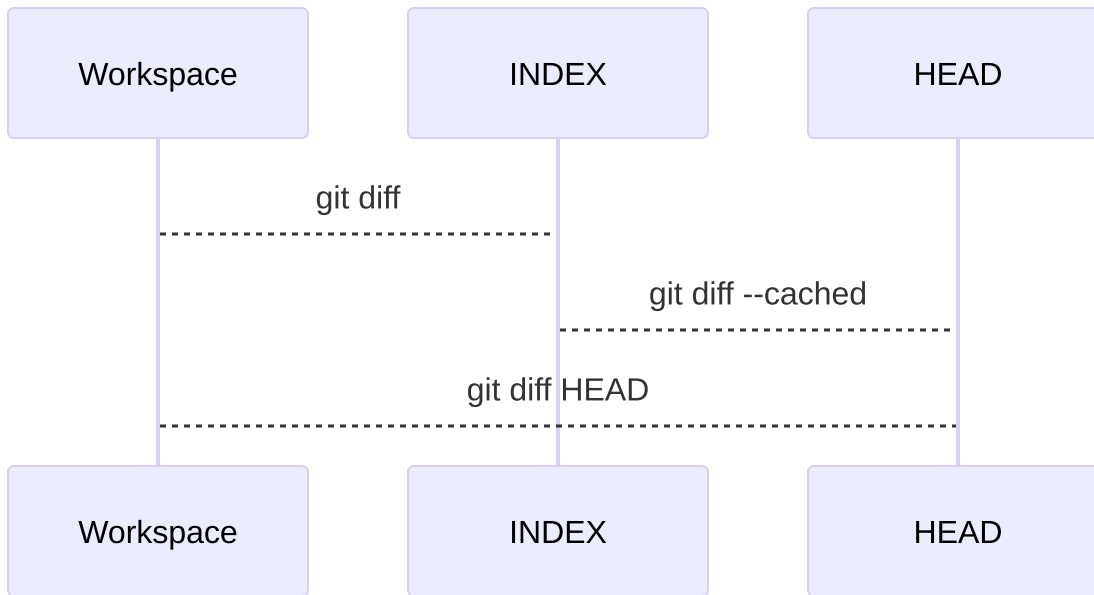
```
git push
```

pull

to update your local working directory to the newest commit, to fetch and merge remote changes

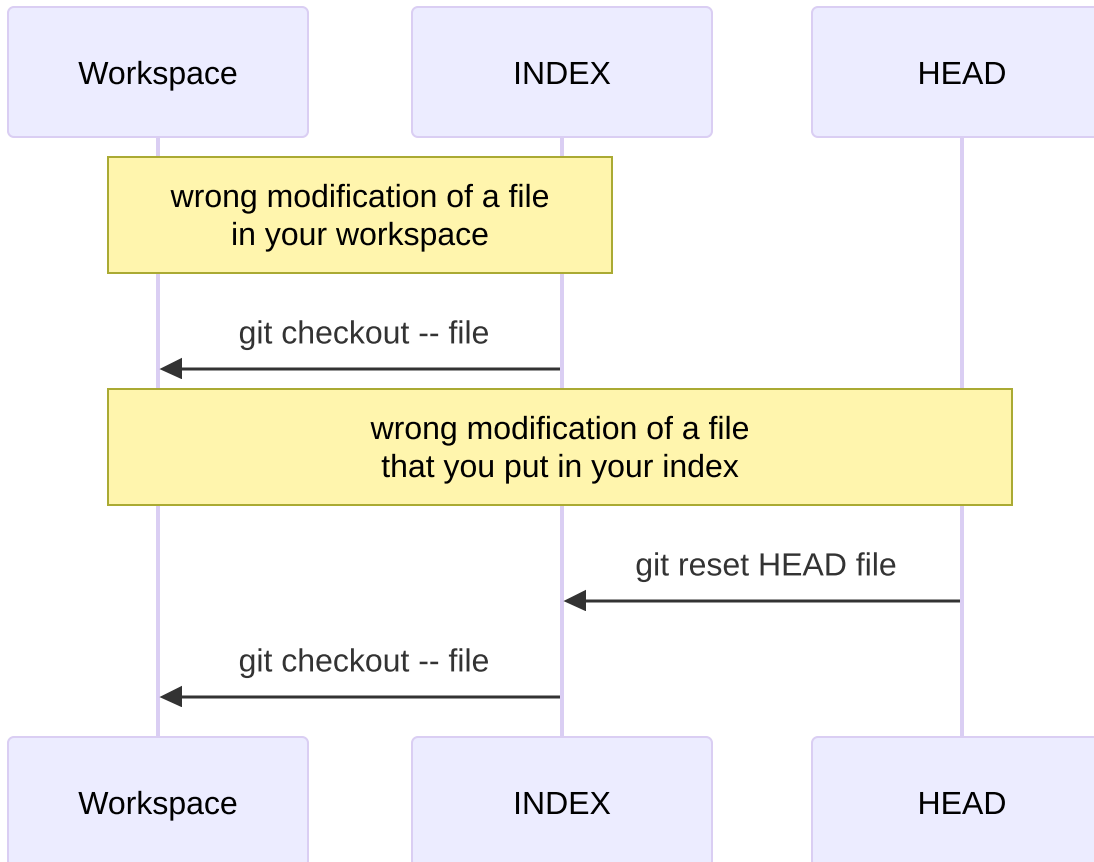
```
git pull
```

git diff



git undo

In case you did something wrong (which for sure never happens 😊)



Simple Git Exercises

First, configure your environment (just once) 🚧

on your laptop, on your UCLouvain account, etc

```
git config --global user.name "Your Name"
git config --global user.email "foo@bar.be"
git config --global color.ui auto
git config --global core.editor "vim"

git config --list
```

Now, clone <https://forge.uclouvain.be/elic/learning.git>

Theses are very simple exercices to learn to manipulate git.

In each folder, simply run `./create.sh` in `learning-git` folder, and follow the guide 😎

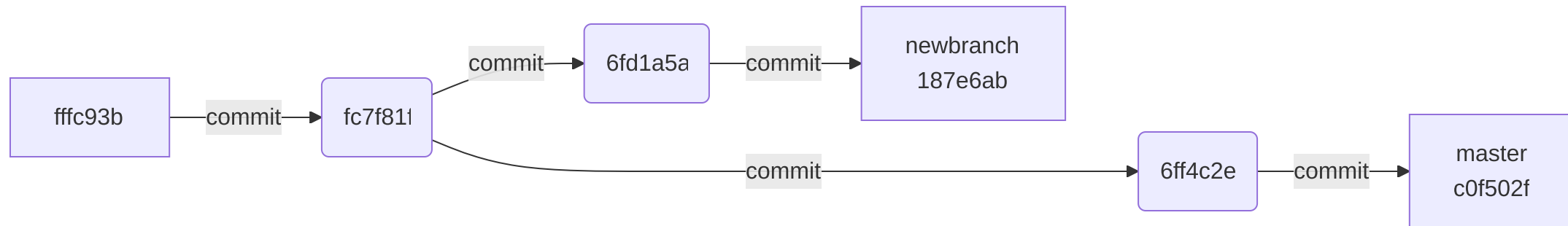
git branches

- a **branch** is pointer to a commit (represent an history)
- a **branch** can point at other commit
| it can move !
- a **branch** is a way to organize your work and working histories
- since commits know which commits they are based on, **branch** represents a commit and what came before it
- a branch is cheap, you can have multiple **branch** in the same repository and switch your working dir from one **branch** state to another

branches demo

```
git commit
git checkout -b newbranch
git checkout newbranch
git commit
git commit
git checkout master
git commit
git commit
```

default branch: **master**



- create a new branch : `git checkout -b newbranch`
- switch to a branch : `git checkout newbranch`
- delete a branch : `git branch -d newbranch`
- list all branches : `git branch -a`
 - | see both local and remote branches

branch is cheap : do it often 👍

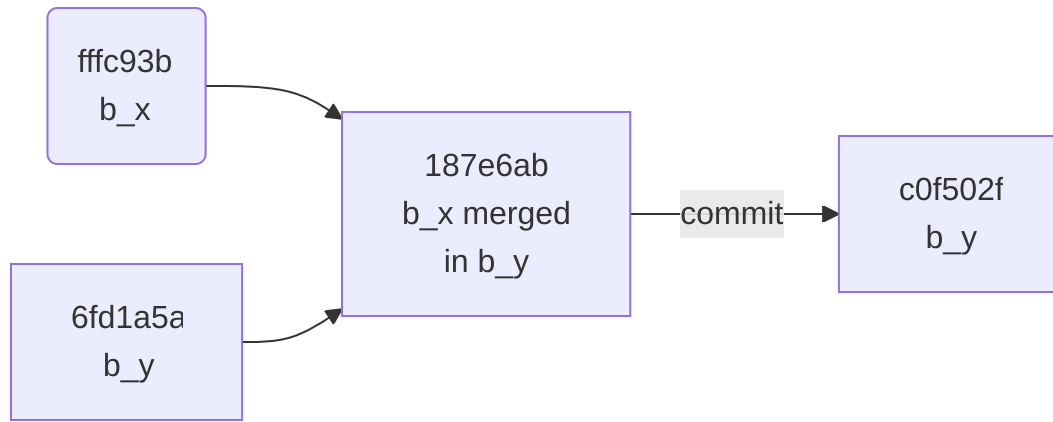
| branch allows to have short/long term parallel development

merging branches

the interest of branch is that you can **merge** them

include in one (branch) file the modification done somewhere else

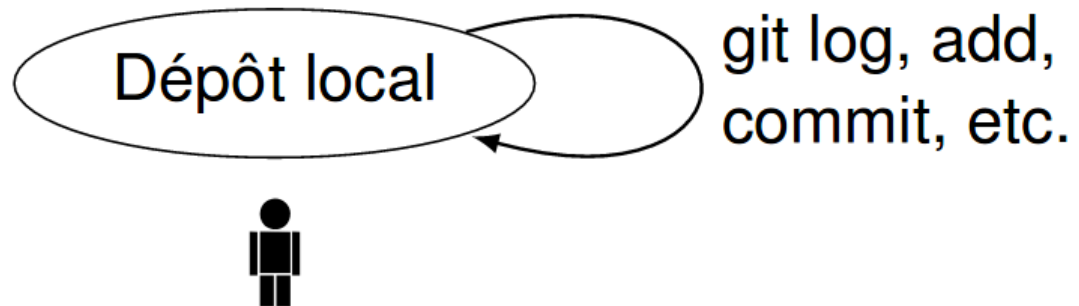
```
git merge bx
git branch -d bx
git commit
```



What is **git** good for ?

Local

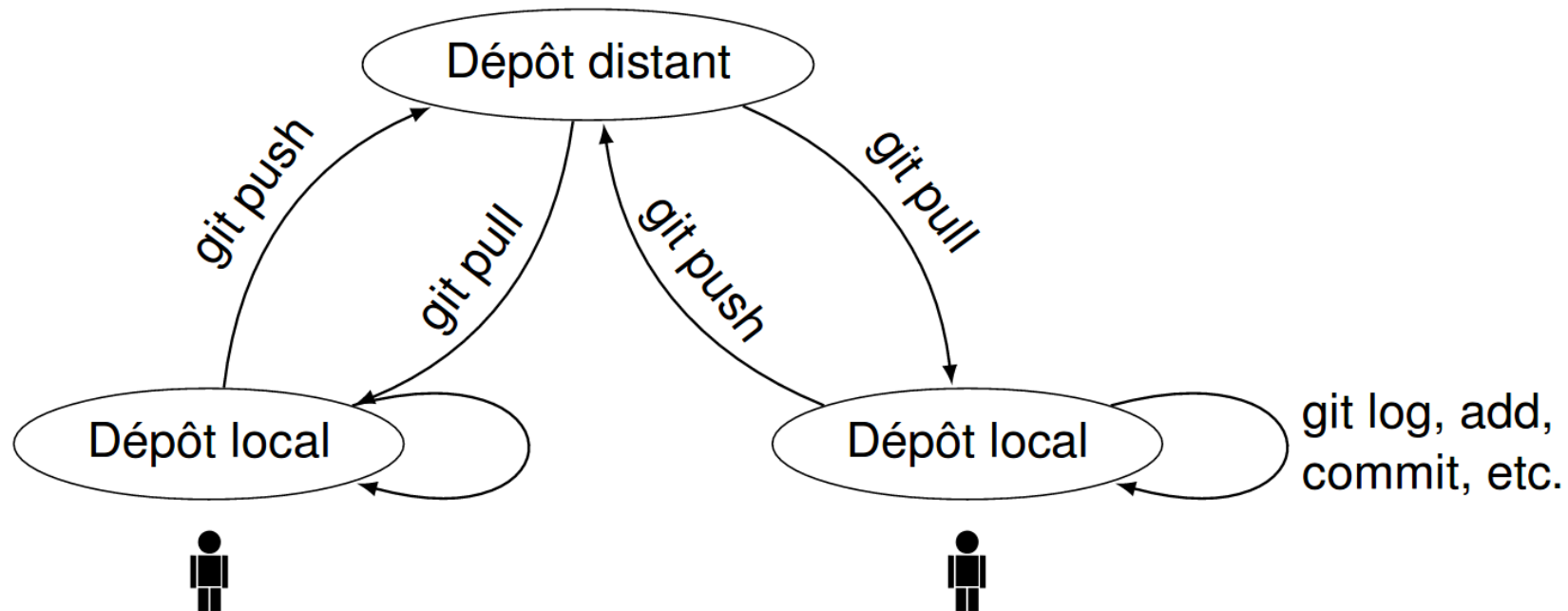
Backup, reproducibility



Utilisation locale

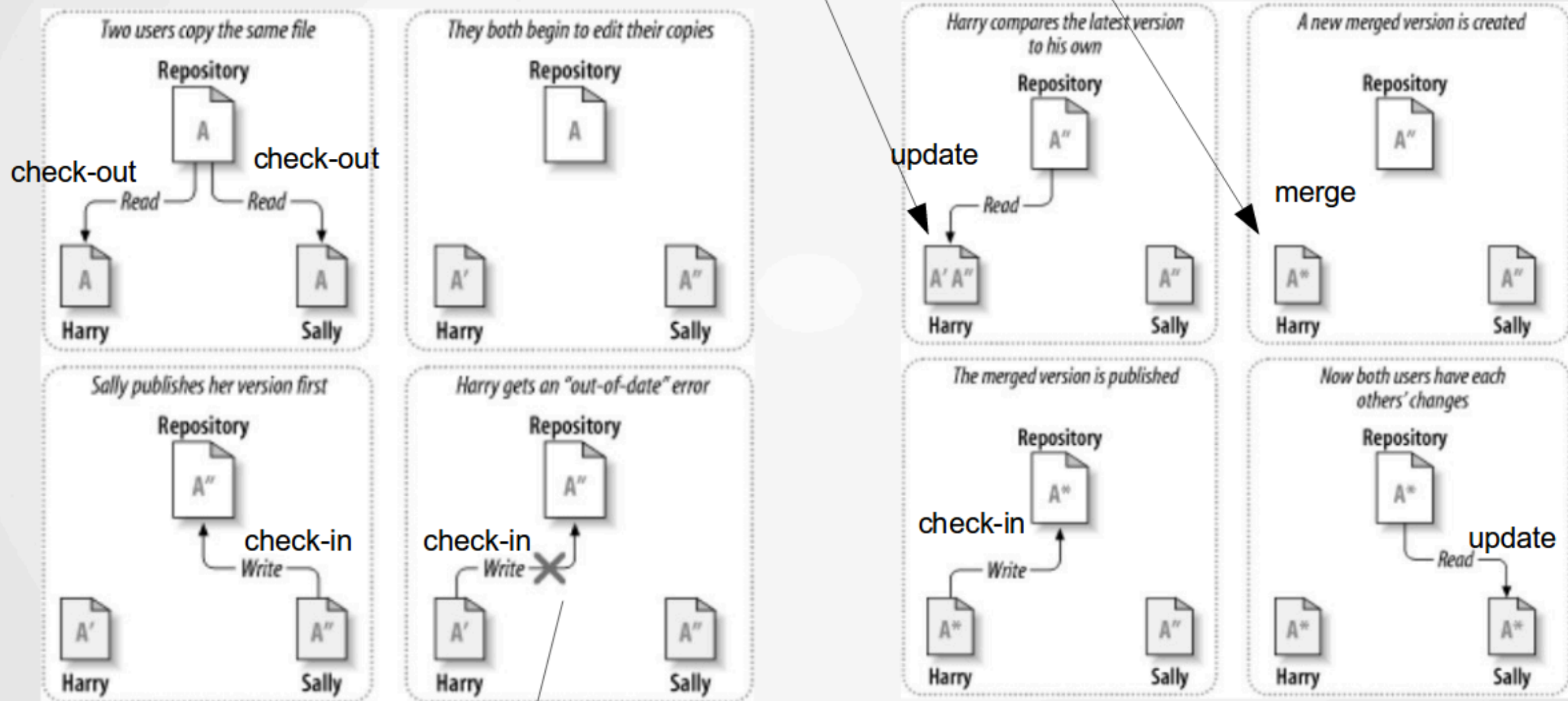
Client-Server

Backup, reproducibility, collaboration



Dépôt commun distant
(Gitolite, Redmine, FusionForge, *GitHub*)

copy-modify-merge solution




cvcs commit: Up-to-date check failed for A

git conflict

multiple version of files are great

- not always easy to know how to merge them
- conflict will happen (same line modify by both user)

conflict need to be resolved manually !

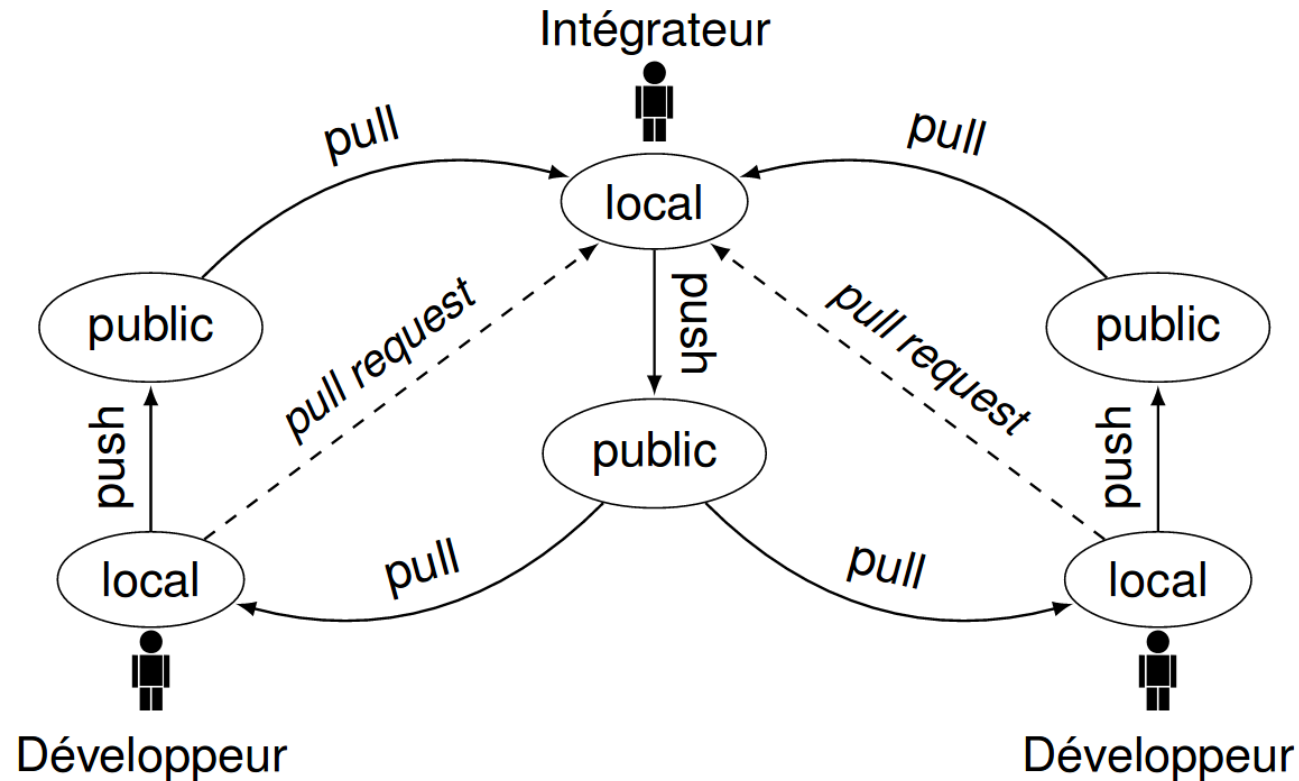
- boring task
- need to understand why a conflict is present !
- **do not be afraid of conflict !** 

Do not try to avoid them at all cost !

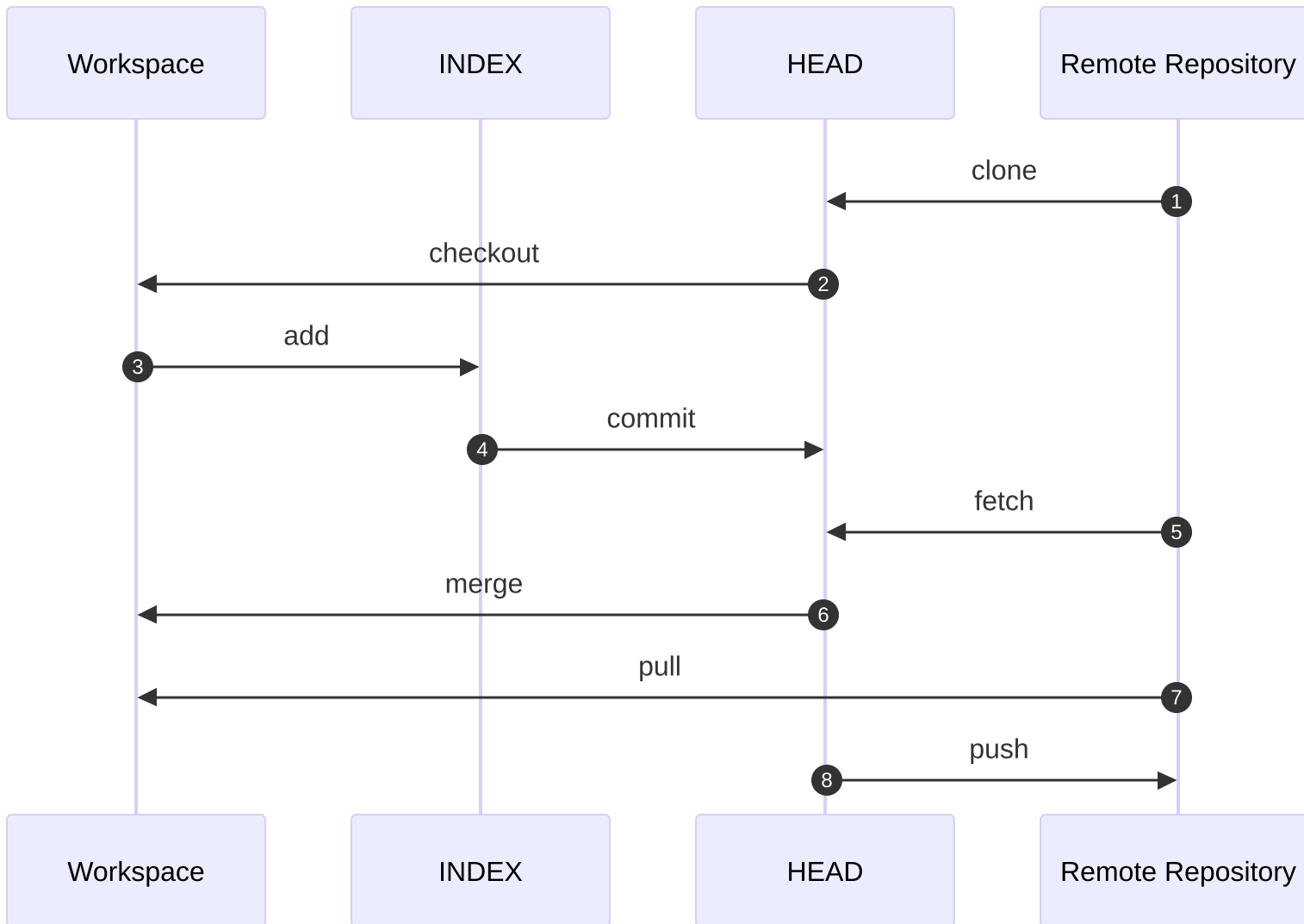
- stay in sync as most as possible and keep line short

Distributed

Backup, reproducibility, collaboration, transparency



Utilisation distribuée (*GitHub*, *Linux*)



Conclusion

- **versioning** is crucial both for small/large project !
- avoid dropbox for paper / project 😞
- do meaningful commit
- do meaningful message
- `git` can seem complicated when you first start using it, but it is standard version control system used by nearly 95% of developers as of 2022 😊
- `git` offers powerful features and flexibility that make it indispensable for collaborative software development

Version control with Git for scientists